California Energy Commission
Public Interest Energy Research (PIER) Program
Buildings End-Use Energy Efficiency Research

Improving Real World Efficiency of High Performance Buildings

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Fact Sheet

The Issue

High-performance buildings are structures designed to achieve maximum possible energy efficiency. The anticipated improvements in energy efficiency in high-performance buildings, however, are not always realized in practice. Addressing this shortfall is critical as the focus on moving toward zero net energy buildings and carbon reduction is increasing pressure to dramatically reduce energy use in buildings.

Results from a 2008 study conducted by New Buildings Institute (NBI) on 121 newly-constructed buildings with high-performance ratings indicated that, while the group was delivering anticipated savings on average, there was a wide degree of variation in individual results. Figure ES-4 to the right shows the measured energy use intensity (EUI) versus the design energy use intensity of 71 Leadership in Energy and Environmental Design buildings with over half the projects deviating by more than 25% from the design projections with 30% significantly better and 25% significantly worse. Building data points on the diagonal line are those where the measured and design energy use intensity are the same.

Project Description

NBI will begin with an assessment of achieved performance levels in selected California high-performance buildings, followed by a series of projects focused on identifying key feedback loops and tools to better inform designers, operators and tenants regarding their role in optimizing building performance.

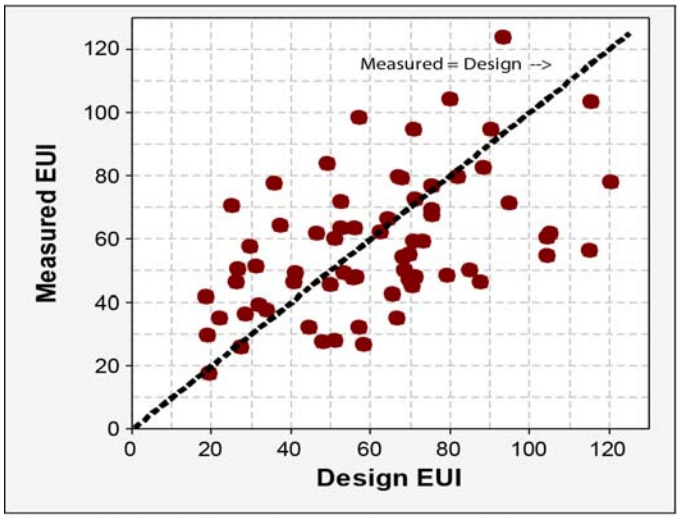

Figure ES- 4: Measured versus Design EUIs
All EUIs in kBtu/sf
Source: New Buildings Institute (2008)

The goals of the collective projects are to:

1) Identify the performance metrics and indicators of high-performance buildings that can predict outcomes, and design reporting tools for feedback to designers and building operators.
2) Measure plugs loads and assesses efficiency measures.
3) Enhance skylight modeling and validate the new models.
4) Complete a fault detection and diagnostics (FDD) protocol evaluator for rooftop units, and support Title 24 improvements on FDD.

Measured Performance. The first project will examine 25 buildings designed to high-performance standards to compare specific building design and operational characteristics with the observed performance levels. Interviews, site visits, data analysis, and focus groups will contribute to the development of key performance reporting metrics and displays. The result will help to separate building performance into aspects attributable to design features, operation and control characteristics, and occupant activities.

Plug Load Savings. Plug loads account for an increasingly large percentage of building energy use, and are largely outside the building designer's control. To assess potential plug load savings, researchers will meter plug load energy use and power demand for 1-2 months in two buildings. The team will implement no- and low-cost measures to reduce plug load energy use and monitor the effects. This research will demonstrate the plug load strategies and energy outcomes to support plug load energy reduction policies, programs and provide market guidance.

Skylight Modeling and Validation. Skylights are often used as an energy saving measure in high-performance buildings. The skylight enhancement project will establish more accurate simulation methods for skylight luminescence distributions for use in existing modeling tools. By comparing computed and measured luminescence distributions of skylights, the project will provide information for design teams to more consistently and successfully integrate daylighting with electric lighting.

Fault Detection and Diagnostics. Fault detection and diagnostics products have the potential to improve the ongoing performance of roof top units (RTUs). The research team will identify and characterize products, services and facility management behaviors related to RTU energy performance The resulting reports will summarize the product approach, features, availability, non-energy benefits, and other factors necessary for assessing marketability and suitability for future standards revisions. This project will contribute to product and cost-benefit information needed to propose a fault detection and diagnostics productas a prescriptive measure in the 2013 Title 24 Non-residential Energy Efficiency Standards revision.

PIER Program Objectives and Anticipated Benefits for California

The objective of this project is to improve the actual energy performance of commercial buildings. This research will help building designers, owners/operators, and tenants use available tools and resources to have buildings perform as designed. Consequently, these buildings will reduce energy consumption and green house gas emissions as intended by the California Building Energy Efficiency Standards Code.

Project Specifics

Contract Number: 500-08-049
Contractor: New Buildings Institute, Inc.
City/County: White Salmon, WA
Application: Statewide
Amount:$1,971,152
Term: June 2009 to November 2012

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